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Volumetric changes at pontic sites with or without soft tissue grafting. A controlled clinical study with a 10-year follow-up

Stefan P. Bienz[1], Irena Sailer[2], Ignacio Sanz-Martin[3], Ronald E. Jung[1], Christoph H.F. Hämmerle[1], Daniel S. Thoma[1]

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Address for correspondence:
PD Dr. Daniel S. Thoma
Clinic of Fixed and Removable Prosthodontics and Dental Material Science
Center of Dental Medicine, University of Zurich
Plattenstrasse 11
CH-8032 Zurich, Switzerland
Phone: +41 44 634 32 51
Fax: +41 44 634 43 05
e-mail: daniel.thoma@zzm.uzh.ch

[1] Clinic of Fixed and Removable Prosthodontics and Dental Material Science, University of Zurich, Zurich, Switzerland

[2] Division for Fixed Prosthodontics and Biomaterials, Center of Dental Medicine, University of Geneva, Geneva, Switzerland

[3] Section of Periodontology, Faculty of Odontology, University Complutense of Madrid, Madrid, Spain

Abstract

Objective: to evaluate volumetric changes of soft tissues at pontic sites in patients treated with or without soft tissue grafting over an observation period of 10 years.

Materials and methods: A total of 17 patients receiving a tooth-borne fixed dental prosthesis (FDP) were enrolled in this study. Nine patients received a subepithelial connective tissue graft at the pontic site (test). Eight patients continued without soft tissue grafting (control). Baseline impressions were taken after delivery of the final FDP and at 10 years. Casts were scanned and digital images superimposed for volumetric and linear measurements: the mean distance (MD) between the surfaces at the mid-buccal area, the pontic height (PH) and the ridge width (RW). All comparisons were performed applying the Wilcoxon-Mann-Whitney test.

Results: The median follow-up time was 123 months. Median MD between baseline and 10 years was -0.64 mm (Min: -2.39; Max: -0.02) (test) and -0.22 mm (Min: -1.07; Max: 0.06) (control). The change of PH (recession) was -0.33 mm (Min: -0.82; Max: 0.06) (test) and -0.17 mm (Min: -0.8; Max: 0.23) (control). The median differences in ridge width 1 mm below the crest were -0.62 mm (Min: -1.17; Max: 0.22) (test) and –0.2 mm (Min: -1.9; Max: 0.28) (control). None of the differences between the groups were significant ($p>0.05$).

Conclusions: Limited by a retrospective study design, pontic sites with or without soft tissue augmentation by means of a SCTG underlie minimal changes over an observation period of 10 years.

CLINICAL RELEVANCE

Scientific rationale for the study: Subepithelial connective tissue grafts (SCTG) are considered the gold standard for soft tissue volume augmentation in partially edentulous patients. Scientific data for longer-term outcomes of sites having been augmented with SCTGs lack in the literature.
Principal findings: A continuous, but minimal volume loss was observed over a 5-year and 10-year period at pontic sites of tooth-supported fixed dental prostheses. No differences were observed between sites with or without previous soft tissue volume augmentation.
Practical implications: Pontic sites with or without soft tissues augmentation remain stable with only minimal linear and volumetric changes over time.

Introduction

Fixed dental prostheses (FDP) are a common therapeutic treatment modality to replace missing teeth in partially edentulous patients. FDPs are well documented in clinical studies with long-term data and based on systematic reviews with high survival and success rates (Sailer et al., 2009, Sailer et al., 2007, Lulic et al., 2007, Tan et al., 2004, Pjetursson et al., 2015). In the pontic area, various designs with or without contact to the underlying soft tissues were proclaimed (Johnson & Leary, 1992, Korman, 2015, Gahan et al., 2012). The use of ovate pontics results in highly esthetic outcomes, predominantly because the mucosal margin around the prosthetic tooth can be imitated (Miller, 1996, Krennmair et al., 2011). For that purpose, the soft tissues underneath the pontic site are conditioned using a provisional FDP (Krennmair et al., 2011). This step allows transforming a relatively flat topography into a natural scalloping shape. An excess of soft tissue, however, is needed to imitate the soft tissues of natural teeth.

The soft tissues in pontic sites can be augmented to a certain extent, preferably by means of a subepithelial connective tissue graft (SCTG) (Langer & Calagna, 1982). SCTGs are documented for a number of indications and are considered to be the gold standard for soft tissue volume augmentation around teeth, at implant sites and in partially edentulous sites (Thoma et al., 2014). Data on the long-term stability of sites augmented with SCTGs are scarce and often requested (Bianchi & Sanfilippo, 2004, Bruschi et al., 2012). Moreover, traditional linear measurements using a periodontal probe or an endodontic instrument do not entirely reflect the overall changes of soft tissues. In order to overcome these drawbacks, a method using three-dimensional non-invasive technique was developed. These measurements are based on impressions taken at various time-points, the digitization and later superimposition of these images. In vitro, preclinical and clinical studies were performed and demonstrated that this technique is adequate and accurate and may well serve to analyze volumetric changes of tissues over time (Windisch et al., 2007, Thoma et al., 2010, Schneider et al., 2011).

This technique has recently been applied to evaluate volumetric changes at implant sites, with follow-ups up to one year (De Bruyckere et al., 2015, Schneider et al., 2011, Sanz Martin et al., 2015). Volumetric changes of pontic sites, following augmentation with SCTGs, have been investigated with an observation period up to 5 years (Sanz-Martin et al., 2016). Longer-term data, however, are missing.

The aim of the present study was therefore, to evaluate volumetric changes of soft tissues at pontic sites in patients treated with or without soft tissue grafting over 10 years.

Materials and methods

Study design

The present study was designed as a controlled clinical trial. All admitted patients were selected out of a randomized controlled clinical trial comparing zirconia-ceramic and metal-ceramic FDPs (Sailer et al., 2009). The study was performed at the Clinic of Fixed and Removable Prosthodontics and Material Science, Center of dental Medicine, University of Zurich, Switzerland and ethic approval was granted by the local ethical committee. Out of this patient pool, all 12 patients having received a SCTG at the pontic site were selected for the test group. Twelve additional patients, derived from the same patient pool, not having received any soft tissue augmentation, were randomly chosen to form the control group. All 24 patients were recalled for the 5-year follow-up. Subsequently, a volumetric analysis was performed (Sanz-Martin et al., 2016). Out of these 24 patients, 17 were available for the present 10-year follow-up, 9 belonging to the test group and 8 belonging to the control group (Figure 1).

Prosthetic and surgical procedures

The detailed procedures are described in a previous publication reporting the volume stability at 5 years (Sanz-Martin et al., 2016). In brief, crown preparation of the mesial and distal abutment as well as the delivery of a provisional FDP was performed after the standard of care of the Clinic of Fixed and Removable Prosthodontics and Dental Material Science. The test group then received a SCTG at the prospective pontic area, harvested from the palate by means of a single incision technique (Thoma et al., 2016). After suturing, provisional FDPs were adjusted to avoid pressure on the augmented soft tissue volume. After 4 weeks of healing, conditioning of the pontic area was performed. In the control group, conditioning of the pontic area started at the time of the delivery of the provisional FDP. Finally, the FDPs were cemented.

Clinical examinations

All patients were recalled 1 week after insertion of the final reconstruction (baseline). Apart from clinical and periodontal measurements, alginate impressions were taken. Similar examinations were performed at 5 years (5Y) and again at 10 years (10Y) (Figure 2a-f).

Processing of casts, image acquisition and matching of stereolithographic models

Casts made out of dental stone were meticulously examined for remaining impression material and artifacts in the region of interest. A desktop 3D scanner (Imetric 3D, Courgenay, Switzerland) was used to scan the casts, generating stereolithographic (STL) files. The STL files were then imported into an image analysis software (Swissmeda Software, Swissmeda AG, Zurich, Switzerland). The baseline, 5Y and 10Y STL files were superimposed. A rough alignment of the STL surfaces was done by the software by matching three reference points. The superimposed images were then manually adjusted for an optimal superimposition.

Data evaluation

The following outcome measures were assessed:

Volumetric measurements

i) A region of interest (ROI) was selected buccally at the pontic site. The coronal border of the ROI followed the mucosal margin on the baseline scan and reached to the mesial and distal line angles. The apical limit was located 5-6 mm below the mucosal margin at the line angles (Figure 3). The mesio-distal extension of the ROI was determined by the connectors of the FDP, thus corresponding to the length of the pontic. The software calculated the enclosed volume and the mean distance between the surfaces. The values are presented as mean distance (MD) because the value is highly independent of the size of the selected region of interest, compared to a volume. The differences between baseline and 5Y (mm; MD5) and between baseline and 10Y (mm; MD10) were measured. For the 5Y to 10Y period (mm; MD5-10), the difference between the two measurements was calculated (Figure 1).

Linear measurements

ii) A longitudinal slice, representing the tooth axis and dividing the pontic into two equal parts, was selected to measure the pontic height (PH). In order to exclude inaccuracies due to tooth wear, PH was measured from the incisal edge of the baseline STL surface to the mucosal margin of the baseline, 5-year and 10-year STL surface. The differences between baseline and 5Y (mm; $PH5_{change}$) and between baseline and 10Y (mm; $PH10_{change}$) were measured and the 5Y to 10Y period ($PH5\text{-}10_{change}$) was calculated as difference between the two (Figure 4a).

iii) Similar to PH, measurements were performed at the mesial (mm; $MA5_{change}$; $MA10_{change}$; $MA5\text{-}10_{change}$) and distal abutment (mm; $DA5_{change}$; $DA10_{change}$; $DA5\text{-}10_{change}$) tooth.

iv) The transversal slice, in the center of the pontic, was used to assess the buccal ridge width at the pontic site. Horizontal measurements were performed at 1mm (mm; $RW1/5_{change}$; $RW1/10_{change}$; $RW1/5\text{-}10_{change}$), 3mm (mm; $RW3/5_{change}$; $RW3/10_{change}$; $RW3/5\text{-}10_{change}$) and 5mm (mm; $RW5/5_{change}$; $RW5/10_{change}$; $RW5/5\text{-}10_{change}$) below the mucosal margin and differences between the time-points were calculated (Figure 4b). These measurements represented changes in horizontal tissue thickness at the pontic site.

Statistical analysis

Data were computed in Excel (Microsoft Corporation, Redmond, USA) and statistical analysis was performed with SAS 9.4 (SAS Institute Inc., Cary, NC, USA). All comparisons of the two group medians were performed with Wilcoxon-Mann-Whitney test and the level of significance was set at 5%.

Results

All pontic sites healed uneventfully and FDPs were provided to all patients. The descriptive results are summarized in table 1. The median age of all participants was 55.9 (Min: 32.1; Max: 71.8) years at the 5-year follow-up and 60.6 (Min: 36.5; Max: 76.8) years at the 10-year follow-up. The median follow-up time was 62 months (Min: 57.2; Max: 66.4) at 5 years and 123 months at 10 years (Min: 96; Max: 149).

The calculated median changes of the mean distance (MD) between baseline and 5 years (MD5) were -0.27 mm (Min: -1.14; Max: 1.01) (test) and -0.17 mm (Min: -0.42; Max: 0.27) (control). Median MD changes between baseline and 10 years (MD10) were -0.64 mm (Min: -2.39; Max: -0.02) (test) and -0.22 mm (Min: -1.07; Max: 0.06) (control). The MD changes between 5 and 10 years (MD5-10) amounted to -0.31 mm (Min: -1.8; Max: 0.5) (test) and to -0.15 mm (Min: -0.78; Max: 0.12) (control). The differences between the two groups were not statistically significant with p-values higher than 0.13. Scatterplots are provided in figure 5, illustrating a trend of a higher variance in the test group.

The median differences in pontic height at 5 years ($PH5_{change}$) amounted to -0.25 mm (Min: -1.64; Max: 0.07) (test) and to -0.31 mm (Min: -0.66; Max: -0.05) (control). At 10 years, $PH10_{change}$ was -0.33 mm (Min: -0.82; Max: 0.06) (test) and -0.17 mm (Min: -0.8; Max: 0.23) (control). $PH5\text{-}10_{change}$ was -0.01 mm (Min: -0.69; Max: 0.98) (test) and 0.09 mm (Min: -0.62; Max: 0.82) (control). The differences between the groups were not statistically significant ($p>0.4$).

Values for the mesial and distal abutment are presented in table 1. In summary, all values were minimally decreasing over time in both groups.

The median difference in ridge width 1 mm below the crest over 5 years ($RW1/5_{change}$) was -0.29 mm (Min: -0.9; Max: -0.16) (test) and –0.4 mm (Min:-0.78; Max: -0.13) (control). At 10 years, $RW1/10_{change}$ amounted -0.62 mm (Min: -1.17; Max: 0.22) (test) and –0.2 mm (Min: -1.9; Max: 0.28) (control). Between 5 and 10 years, $RW1/5\text{-}10_{change}$ was -0.29 mm (Min: -0.78; Max: 0.6) (test) and 0.18 mm (Min: -1.1; Max: 0.6) (control). Values obtained at 3 mm and 5 mm below the crest were in a similar range as at the 1 mm level (Table 1). Again, no statistically significant differences existed between the groups ($p>0.05$).

Discussion

The present controlled clinical study evaluated the soft tissue changes at pontic sites over an observation period of 10 years and identified i) no significant differences between the test and the control group for all outcomes measures ii) an overall tissue loss of approximately 0.5 mm within a 10-year period, generalizing the assessed outcomes iii) a slight, but continuous loss of tissue volume from baseline to 5 and 10 years.

The vertical component represented by pontic height measurements recorded a tissue loss of 0.3 mm within the first five-year period, but no further tissue alterations with values close to 0 mm within the second 5-year period in both groups. However, the horizontal component represented by ridge width measurements indicated a continuous decrease over the complete observation period. The mean distance indicated a continuous decrease for both groups as well. Additionally, the ridge width indicated greater changes 1 mm below the mucosal margin compared to 3 mm below the mucosal margin and again compared to 5 mm below in both groups. The buccal prominence (margo gingivae of the pontic) of the ridge profile appeared to be the region most prone to volume loss. This might be explained by being the region with the greatest distance from the supporting bone and at the same time being exposed to pressure and chewing forces from the FDP pontic as well as brushing habits. The present results render evidence that sites grafted by means of a SCTG remain as stable as non-grafted sites. The decrease in volume of approximately 0.5 mm over a period of ten years is in line with the findings of other studies performing comparable measurements for the analysis of volumetric changes following soft tissue grafting over shorter observation periods (Sanz-Martin et al., 2016, Schneider et al., 2011, Rebele et al., 2014).

Subepithelial connective tissue grafts are used for soft tissue augmentation in various indications, primarily for root coverage procedures (Cairo et al., 2014) and for augmentation around implants (Thoma et al., 2014). If one intends to investigate the soft tissue stability, pontic sites might be an ideal clinical model. Pontic sites are highly standardized for a number of reasons: stable reference points for matching of data (FDP; healed sites on the bony level (no or only minimal changes being expected); measurements are not influenced by further surgical interventions such as implant placement or bone augmentation procedures and, the soft tissue augmentation surgery at pontic sites compensates for chronic ridge defects. The augmentation area is therefore confined within the envelope of the natural ridge and by neighboring teeth.

The outcomes of the study are limited by the fact that not all phases of wound healing following the surgical intervention (soft tissue grafting) were evaluated and reflected by the linear and volumetric outcomes. Controversial data are reported in the literature in terms of the time-point and the extent of volume loss following soft tissue grafting procedures. The greatest tissue alterations might be expected within the first 3 months after soft tissue grafting surgery. Compared to the volume after surgery, a decrease of 15% was documented during the first three weeks (Rotenberg & Tatakis, 2014), a further decrease of 11% was recorded between 1 month and 3.5 months (Studer et al., 2000). In contrast, tissue stability was reported in a clinical study 4-6 weeks following surgery (Allen et al., 1985). There is even evidence that soft tissue stability can be expected within the first three months after grafting, followed by a reduction of roughly 50% during the subsequent three months (Akcali et al., 2015). These variations in terms of volume changes are certainly due to the lack of standardization in terms of indications, concomitant other surgical interventions, surgical techniques and materials, evaluated time-points and type of measurements. In the present study, the baseline impression in the test group was taken earliest 4 months after surgery according to the treatment protocols of the Clinic of Fixed and Removable Prosthodontics and Dental Material Science, containing a healing phase of 6 weeks after grafting, followed by 8 weeks of tissue conditioning with the provisional FDP and finally a phase of 3 weeks for the fabrication of the final reconstruction. According to the results of the majority of the above mentioned studies, major tissue alterations should have happened before baseline impression. This was also confirmed by the results, indicating similar tissue stability in the first and the second five-year-period.

Subepithelial connective tissue grafts are the preferred technique for soft tissue augmentation since the early eighties (Langer & Calagna, 1982, Abrams, 1980). Even if the volumetric alterations of early and later time-points are documented, there is only scarce knowledge about the tissue integration of transplants at the recipient site. In a preclinical study in the dog mandible, histology at 28 and 84 days after SCTG placement was performed (Thoma et al., 2011). Interestingly, at 28 days, only a limited number of vessels was found. At the later time-point, the number of vessels increased, the connective tissue was denser and the amount was almost stable based on histomorphometric data. Similar findings were made in human biopsies at 90 days after SCTG placement (Thoma et al., 2016). The observed difference in vascularization indicates, that the process of graft integration is still ongoing at four weeks, possibly accompanied by volumetric changes.

The volumetric changes analyzed in this study were generally small and the applied techniques are considered to be highly accurate. Earlier, comparable techniques for volumetric analysis reported inaccuracies below 3% of the analyzed volume (Windisch et al., 2007, Studer et al., 1997). However, these data describe the measurement itself and not the complete workflow. The use of alginate impressions in the present study represents a limitation, as alginate is not the most accurate impression material. Polyether and addition silicone materials are more accurate and less sensitive in terms of storage conditions and storage time (Faria et al., 2008, Chen et al., 2004). Still, alginate was considered to be appropriate since the same technique and impression material was used in a majority of the previously reported studies. Further studies might have to evaluate differences in terms of volumetric/linear measurements using alginate and silicone impression materials.

An advantage of this technique is, that linear measurements such as the pontic height could be performed precisely at the same location using a cross-section of the superimposed stereolithographic surfaces. The linear measurements performed on scanned casts are considered to be more accurate than intraoral measurements using a periodontal probe or measurements made on casts using a caliper (Schneider et al., 2014). When analyzing long-term results, tooth wear becomes a confounding factor, as the reference point at the cusp may change over time. Choosing the reference point on the baseline surface can thus exclude inaccuracies due to tooth wear.

Conclusions

Volumetric and linear changes of the soft tissues at pontic sites demonstrated were minimal over an observation period of 10 years. No significant differences between sites with or without previous soft tissue volume augmentation using SCTGs were observed. Data are limited, however, due to a retrospective study design.

Acknowledgements and conflict of interest

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Figure Legend

Figure 1 Schematic drawing of patient selection, the follow-up visits and the performed measurements. FDP = fixed dental prosthesis; SCTG = subepithelial connective tissue graft.

Figure 2a-f Fixed dental prosthesis of the test group (a-c), with a pontic at site 16. Figures d-f represent a case of the control group, with the pontic at site 14. Photographs were taken at baseline (a+d), 5-year follow-up (b+e) and 10-year follow-up (c+f).

Figure 3 The selected region of interest (ROI) in blue along the pontic site illustrates the area chosen for the evaluation of the mean distance.

Figure 4a A cross section of the pontic site was chosen to measure PH_{change}. A reference point was selected on the baseline surface (yellow) for the measurement from the buccal cusp to the mucosal margin of the baseline, 5-year (green) and 10-year (grey) surface.

Figure 4b RW_{change} was analyzed at 1 mm, 3 mm and 5 mm below the mucosal margin. The differences between baseline (yellow) and 5 years (green) as well as between baseline and 10 years (grey) were measured, the values for the difference between 5 years and 10 years were calculated.

Figure 5 Scatterplots of the mean distance (MD) at five years and at ten years.

Table 1 Descriptive results of all obtained variables. All variables represent values for the first five-year period (5), the ten-year period (10), and the second five-year period (5-10). MD = mean distance; PH_{change} = Pontic height change; MA/DA_{change} = mesial/distal abutment change; $RW1/RW3/RW5_{change}$ = ridge width change at 1/3/5 mm below the buccal mucosal margin.

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Group	Variable	N	Mean	Std	Min	Q1	Median	Q3	Max
control	Age at 5Y (years)	8	51.86	10.76	39.30	44.10	48.35	61.05	68.60
control	Follow-up at 5Y (months)	8	62.88	2.40	59.20	60.70	63.80	64.80	65.30
control	Age at 10Y (years)	8	55.63	11.28	42.00	47.40	52.35	65.70	72.10
control	Follow-up at 10Y (months)	8	117.75	13.25	96.00	108.00	121.50	125.50	136.00
control	MD5	8	-0.11	0.25	-0.42	-0.28	-0.17	0.06	0.27
control	MD10	8	-0.29	0.34	-1.07	-0.34	-0.22	-0.11	0.06
control	MD5-10	8	-0.18	0.31	-0.78	-0.32	-0.15	0.09	0.12
control	$PH5_{change}$	8	-0.32	0.22	-0.66	-0.48	-0.31	-0.13	-0.05
control	$PH10_{change}$	8	-0.23	0.38	-0.80	-0.55	-0.17	0.10	0.23
control	$PH5\text{-}10_{change}$	8	0.09	0.52	-0.62	-0.26	0.09	0.44	0.82
control	$MA5_{change}$	8	-0.06	0.17	-0.27	-0.17	-0.06	0.01	0.26
control	$DA5_{change}$	8	-0.29	0.32	-0.98	-0.38	-0.22	-0.06	-0.03
control	$MA10_{change}$	8	-0.26	0.38	-0.86	-0.43	-0.30	-0.12	0.43
control	$DA10_{change}$	8	-0.56	0.51	-1.35	-0.96	-0.46	-0.16	-0.03
control	$MA5\text{-}10_{change}$	8	-0.21	0.17	-0.84	-0.55	-0.19	0.17	0.70
control	$DA5\text{-}10_{change}$	8	-0.28	0.71	-1.21	-0.81	-0.30	0.14	0.94
control	$RW1/5_{change}$	8	-0.38	0.20	-0.78	-0.45	-0.40	-0.23	-0.13
control	$RW3/5_{change}$	8	-0.36	0.24	-0.85	-0.46	-0.32	-0.19	-0.08
control	$RW5/5_{change}$	8	-0.45	0.08	-0.87	-0.61	-0.38	-0.15	-0.16
control	$RW1/10_{change}$	8	-0.33	0.67	-1.90	-0.30	-0.20	0.00	0.28
control	$RW3/10_{change}$	8	-0.48	0.54	-1.64	-0.61	-0.36	-0.15	0.02
control	$RW5/10_{change}$	5	-0.38	0.31	-0.69	-0.65	-0.41	-0.14	0.00
control	$RW1/5\text{-}10_{change}$	8	0.06	0.51	-1.12	0.03	0.18	0.31	0.56
control	$RW3/5\text{-}10_{change}$	8	-0.12	0.38	-0.79	-0.32	-0.12	0.13	0.43
control	$RW5/5\text{-}10_{change}$	5	-0.01	0.18	-0.32	-0.02	0.05	0.07	0.16

Group	Variable	N	Mean	Std	Min	Q1	Median	Q3	Max
test	Age at 5Y (years)	9	56.18	12.98	32.10	53.50	58.80	65.00	71.80
test	Follow-up at 5Y (months)	9	61.24	2.58	57.20	60.00	61.10	62.50	66.40
test	Age at 10Y (years)	9	60.59	12.96	36.50	58.00	61.50	69.70	76.80
test	Follow-up at 10Y (months)	9	126.67	8.85	120.00	122.00	123.00	127.00	149.00
test	MD5	9	-0.24	0.59	-1.14	-0.58	-0.27	-0.17	1.01
test	MD10	9	-0.72	0.72	-2.39	-0.78	-0.64	-0.33	-0.02
test	MD5-10	9	-0.48	0.82	-1.80	-0.58	-0.31	0.06	0.50
test	$PH5_{change}$	9	-0.39	0.53	-1.64	-0.52	-0.25	-0.06	0.07
test	$PH10_{change}$	9	-0.38	0.35	-0.82	-0.66	-0.33	-0.06	0.06
test	$PH5\text{-}10_{change}$	9	0.01	0.48	-0.69	-0.15	-0.01	0.02	0.98
test	$MA5_{change}$	9	-0.40	0.32	-1.01	-0.66	-0.27	-0.16	-0.01
test	$DA5_{change}$	9	-0.38	0.31	-0.90	-0.60	-0.27	-0.20	0.04
test	$MA10_{change}$	9	-0.31	0.40	-0.84	-0.64	-0.27	-0.11	0.46
test	$DA10_{change}$	9	-0.20	0.27	-0.64	-0.41	-0.16	-0.05	0.14
test	$MA5\text{-}10_{change}$	9	0.08	0.21	-0.68	-0.56	-0.02	0.52	1.16
test	$DA5\text{-}10_{change}$	9	0.18	0.46	-0.40	-0.21	0.21	0.59	0.85
test	$RW1/5_{change}$	9	-0.36	0.23	-0.90	-0.42	-0.29	-0.19	-0.16
test	$RW3/5_{change}$	9	-0.47	0.21	-0.80	-0.70	-0.38	-0.30	-0.26
test	$RW5/5_{change}$	9	-0.46	0.09	-0.97	-0.73	-0.33	0.13	-0.19
test	$RW1/10_{change}$	9	-0.62	0.43	-1.17	-0.91	-0.62	-0.40	0.22
test	$RW3/10_{change}$	9	-0.64	0.72	-1.94	-1.11	-0.46	-0.39	0.36
test	$RW5/10_{change}$	6	-0.63	0.48	-1.35	-1.13	-0.37	-0.29	-0.27
test	$RW1/5\text{-}10_{change}$	9	-0.26	0.42	-0.78	-0.49	-0.29	-0.21	0.60
test	$RW3/5\text{-}10_{change}$	9	-0.17	0.73	-1.49	-0.65	-0.09	0.32	0.88
test	$RW5/5\text{-}10_{change}$	6	-0.30	0.42	-1.03	-0.60	-0.07	-0.03	0.01

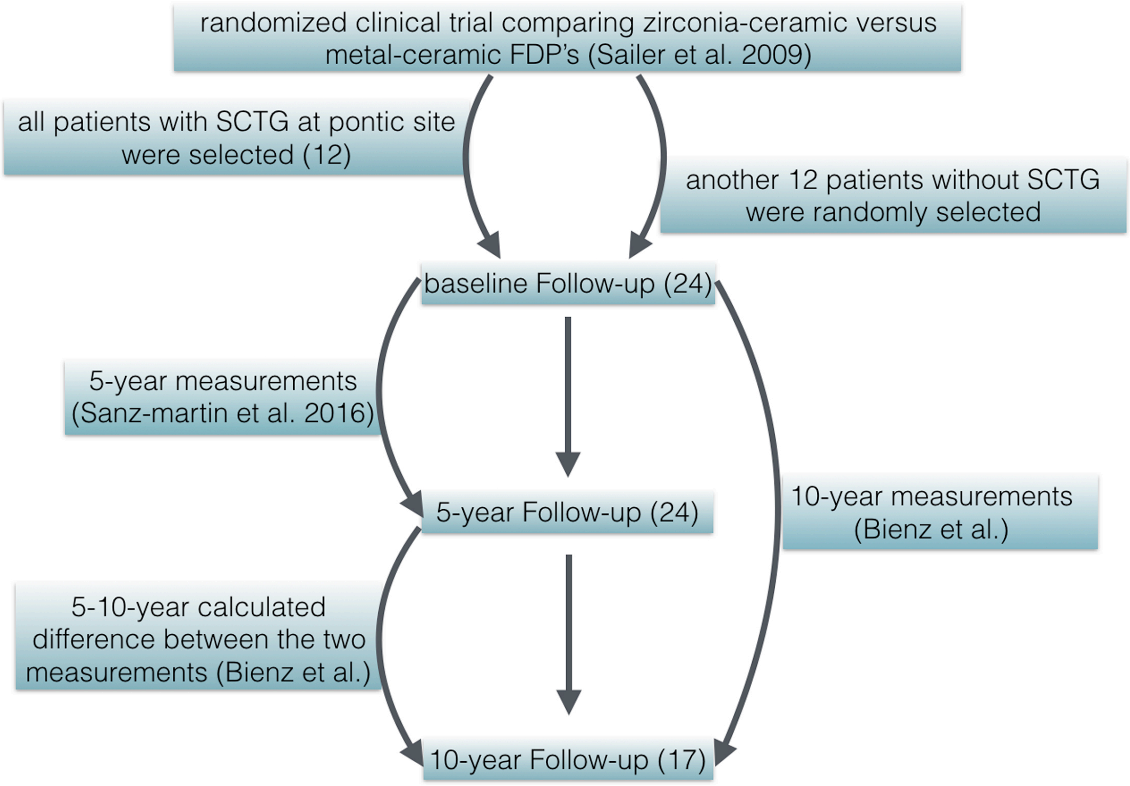

Figure 1

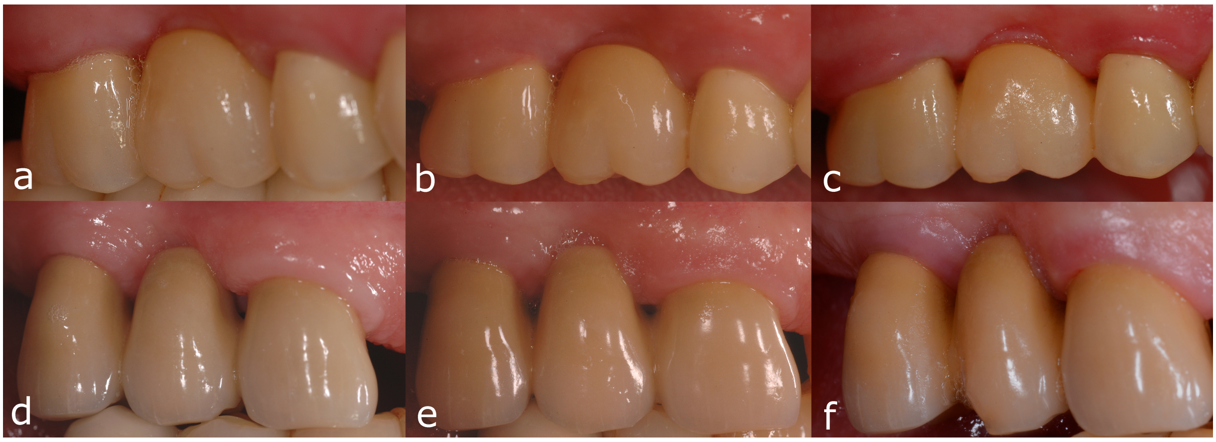

Figure 2

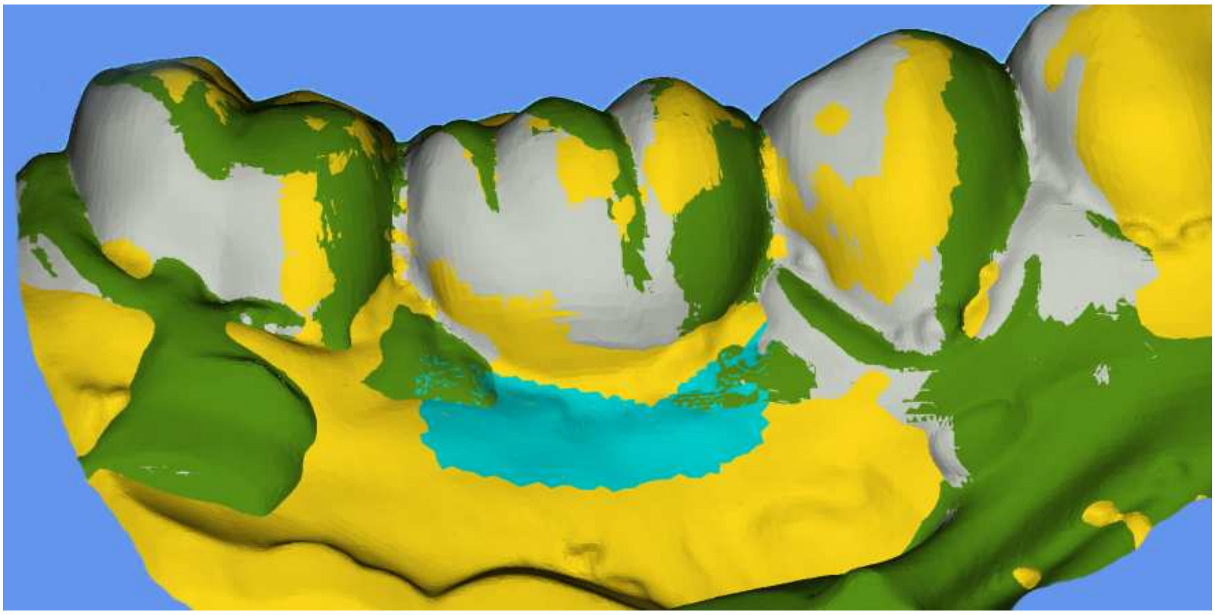

Figure 3

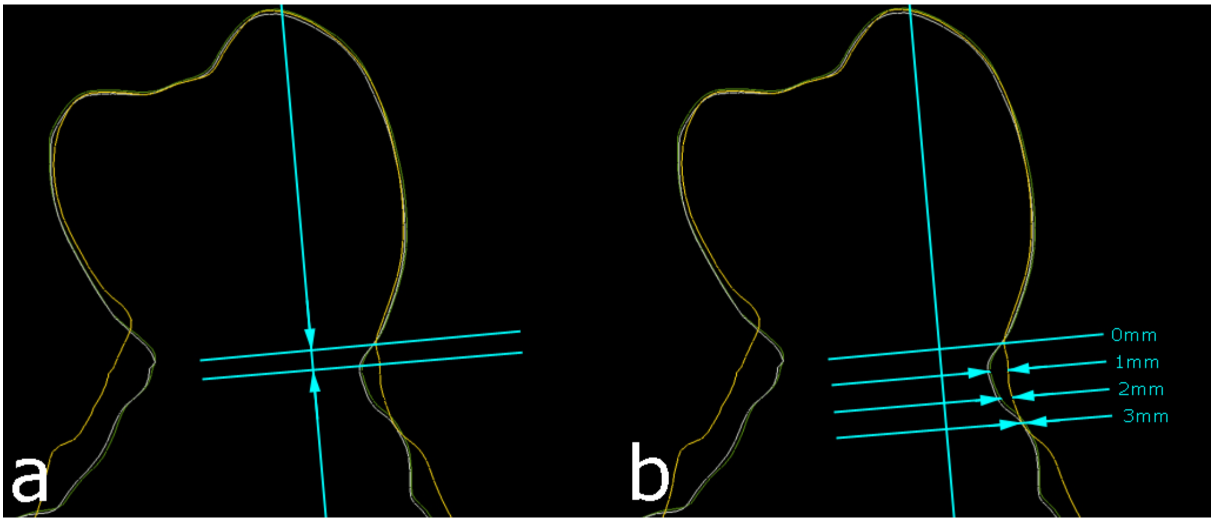

Figure 4

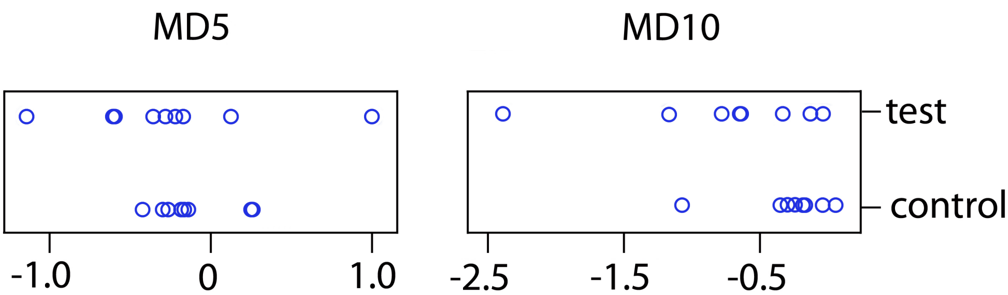

Figure 5